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APCC12 Abstracts

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ABSTRACTS

PRESENTATIONS – DAY 1 (in order of appearance)

PLENARY – Australian plant translocations: a 60,000 year history

Dr Jen Silcock Threatened Species Recovery Hub, University of Queensland

The prevalence and imperative of translocation for the conservation of plant species is increasing in response to habitat loss and degradation, plant diseases, and projected climate change. However the intentional movement and nurture of propagules to increase species' ranges and/or abundances has been practiced for millennia, encompassing plants with food, medicinal, narcotic, and ceremonial values. A review of the ethnographic, archaeological, biogeographic and phylogenetic record reveals more than 50 plants that were - and in some areas still are - intentionally dispersed, planted and/or nurtured in Aboriginal Australia, spanning much of the continent and numerous lifeforms and plant uses. While we will never know the full extent and nature of these ancient translocations, there is sufficient evidence to place the 'emerging' science of translocation in a much older context. This allows for more nuanced discussion around the practice and ethics of translocation, as well as re-evaluation of 'natural' plant distributions.

The first well-documented conservation translocations were carried out in Victoria in the late 1970s. Over the past four decades, translocation has expanded to become common practice for conservation of some of Australia's most imperilled plants, and for development mitigation. The vast majority of data on these translocations is unpublished, and there is no clear picture of what has been done, or how successful translocations have been. We compiled data on as many plant translocations as possible across Australia, through an extensive literature review and expert interview process. We documented 1001 translocations involving 376 taxa, spanning all Australian States and Territories except the Northern Territory. We explored the characteristics of these translocations, including where and in what habitats they have been concentrated, what species have been involved, when and how they have been done, and what they have aimed to achieve.

For 760 translocations with sufficient data to assess success, 40% have <10 plants surviving, and have thus failed to establish viable populations or substantially augment existing ones. A further 11% contain <30 plants and have no recruitment, and seem unlikely to become viable populations in the absence of further augmentation. One-third of translocations have a number of plants surviving comparable to natural populations, but no recruitment (although for many of these, it is probably too early). Only 16% of translocations have >50 plants surviving and some recruitment observed, and so can be considered on track for long-term success. Success is strongly correlated with plant life form, habitat and translocation type, while reasons for success or failure often relate to prevailing climate conditions, management actions (e.g. fencing, watering, weeding, burning), and inherent species biology.

Plant translocation has an ancient history in Australia, but has burgeoned in the past four decades in response to increasing pressures on habitats and species. Our synthesis of what has been done, and importantly what has worked and has not, can underpin translocation science in Australia into an uncertain future.

Moving plants – revealing the past and informing the future

Dr Margaret Byrne **Dr Margaret Byrne** WA Department of Biodiversity, Conservation and Attractions

Changing climate has led to calls for implementation of adaptation strategies to ensure ecosystem resilience. Assisted migration is advocated for movement of species outside their current range when current climate becomes unsuitable. Assisted gene migration and climate adjusted provenancing have been advocated as strategies to improve the resilience and adaptive capacity of key species in ecosystems spanning climate gradients. These climate adaptation strategies require a solid evidence base for implementation in conservation and ecosystem management. Genetic analysis can provide such evidence to support or refute these strategies, both in terms of understanding historical responses to climate change, and in assessing signals of adaptive capacity in current distributions. Phylogeographic analysis of plants in southern Australia reveals multiple levels of divergence and complex structuring and these genetic signatures of high diversity and endemism indicate persistence of the biota through climatic oscillations over multiple glacial cycles as a major response to changing climatic conditions. Persistence through time indicates that species may have wider climatic tolerance than their current distributions imply. Genomic analysis in widespread plants distributed across climate gradients reveals signatures of adaptive capacity in most species, with evidence of genetic adaptation to temperature and/or rainfall. This adaptive capacity can be harnessed by moving seed from hot dry environments into less harsh environments ahead of climate change to increase the frequency of adaptative genes in populations to cope with more arid conditions. Genetics analyses support climate adaptation strategies that mimic historical gene flow and maintain genetic diversity required for adaptation to changing climates.

How well is genetic diversity captured in revegetation plantings?

Dr Rebecca Jordan, CSIRO
(co-authors Martin Breed, Ary Hoffmann, Suzanne Prober)

Genetic diversity is essential for creating adaptable, self-sustaining revegetation populations under environmental change. Whilst revegetation may be expected to have lower genetic diversity due to the founder effects of seed sourcing, this is not always the case. Determining how well genetic diversity is captured in revegetation and the management choices that influence this could help improve resilience and adaptability of future revegetation plantings. Here we review the published studies that report genetic diversity in natural and revegetated plant populations to determine, how genetic diversity in revegetation compares to natural populations, and what factors influence this. A literature search identified 49 studies from around the world, including 7 from Australia, representing 22 plant families. Preliminary findings demonstrate restoration plantings can have as much, and sometimes greater, genetic diversity than natural sites. This, however, varies widely between plantings. One key finding is a clear lack of metadata on the details of seed collection and revegetation plantings, which is crucial information to improving management actions. Metadata on seed sourcing approaches, including the number of seed mothers and source populations, was rarely reported and in some cases, stated as unknown. These results highlight not only the heterogeneity of how well revegetation captures source genetic diversity, but also the importance of metadata and monitoring to provide feedback and improve revegetation decisions.

Survival outcomes of *Cycas megacarpa* across two translocation programmes

Alicia Wain, Ecologica

Cycas megacarpa is listed as Vulnerable under the IUCN Red List Category and Criteria, version 3.1 (2010) and is recognised as a nationally threatened species that is endemic to Queensland, Australia where it has an estimated occupancy range of 2,527ha (Queensland Herbarium, 2007). Between 2009 and 2014 several major linear infrastructure projects directly impacted upon over 2000 individuals within the same significant and viable population of *Cycas megacarpa*, in Central Queensland, Australia. To manage and mitigate the ecological impact, the State and Commonwealth governments tasked all of the projects with undertaking translocation programmes to support the species survival. Although the specific approval conditions differed between the projects, all were generally required to identify suitable offset and recipient site locations that met the biological and ecological requirements of the taxon as well as: salvage those directly impacted; collect seed from the same population being impacted; propagate and plant out the juvenile specimens back into the population; and monitor and maintain the planted populations for long term success. This presentation will discuss the programmes, including the constraints experienced and the survival rates for three of these programmes, one of which is now entering its 9th Year post translocation.

Measuring and managing genetic erosion in plant translocation: lessons from *Grevillea scapigera*

Dr Siegy Krauss, Kings Park Science
(co-authors Bob Dixon, Bronwyn Ayre, Dr Janet Anthony)

Plant reintroductions typically start from a limited genetic base. When that genetic base is known, an opportunity to quantify genetic erosion and test the genetic consequences of small founding population size through generations in a natural experiment is enabled. The Corrigin Grevillea, *G. scapigera*, has been the focus of a sustained recovery program for over 20 years. Translocation trials were first established in 1996 with what were thought to be equal numbers of 10 genets, ramets of which were propagated by tissue culture. Subsequent plantings occurred in following years, largely from seed harvested at this site. Flowering and natural seed set has been very high in all years, and some natural recruitment occurred in most years. In 1998, 2007 and 2012 we genotyped plants and a sample of their seed to assess genetic fidelity and genetic erosion over multiple generations. Following establishment, we found that eight genets, not ten, were present. Critically, 54% of all plants were a single genotype, and the F1's were on average 22% more inbred than their parents. The genetic consequences of this initial dramatic erosion on descendants 20 years later will be presented. A positive association between survivorship and increasing genetic dissimilarity of parents of seedlings indicates inbreeding depression associated with genetic erosion. Our results highlight that rapid genetic erosion may be a feature of many small, translocated populations, which may ultimately threaten their long-term survival. Strategies to prevent genetic decline in rare species translocations are discussed.

PLENARY – Plant conservation actions and comparative ecology: But we don't know enough!

Dr Peter Vesk , University of Melbourne

Roughly 300,000 species of seed plants exist in the world. We have good ecological knowledge about relatively few of them and know much less about most. The ability to generalise knowledge from one situation to another is a central feature of science. Moreover, generalisation is crucial to conservation and ecological management when we wish to manage species with little direct recorded knowledge. In this talk I will discuss the challenges of learning fast and effectively in order to do conservation well. I will describe how my colleagues and I have been working through the problem of generalising ecological knowledge and in particular the use of statistical models for species responses involving species traits. I will draw on case studies of species distribution, growth responses after fire, and urbanisation.

Physiological patterns among trees can aid land-management decisions under a changing climate

Dr John Patykowski Deakin University
(co-authors Dr Matt Dell, Dr Tricia Wevill, Dr Maria Gibson)

Climate change will alter the frequency and duration of drought in many parts of the world, affecting the distribution and composition of ecological communities. Exploring the effect of short-term weather patterns (e.g. below-average rainfall) on the physiological performance of trees is a step towards predicting long-term change in communities. From this, we can determine if and how ecosystems should be managed to ensure functional stability. Photosynthetic rate, transpiration, and water-use efficiency was examined across four seasons for six species of Eucalyptus forming the canopy of a box-ironbark forest in south-east Australia, during a year of severe rainfall deficit. One of the least abundant species, *Eucalyptus melliodora*, displayed the lowest rates of photosynthesis throughout the year; competitive pressure may further reduce its presence if droughts become more common and extreme. Conversely, *Eucalyptus goniocalyx*, which also was low in abundance, displayed the highest rates of photosynthesis and water-use efficiency, and may be better adapted to cope with frequent drought and warmer temperatures. All species were most active in winter and spring. Physiological performance was highly variable among individuals within each species. Thus, the effect of site-level habitat variability in mediating resources is probably as influential as innate ecophysiological tolerances for determining the competitive ability of an individual tree. The selection of species for land restoration should consider likely future climates and the formation of novel communities, and the provision of assisted migration to species at the thresholds of currently suitable habitat.

Restore & Renew: Large scale evolutionary, environmental and ecological information in support of restoration practices

Dr Maurizio Rossetto, Royal Botanic Garden Sydney

Restore & Renew is an initiative aimed at creating a comprehensive and easy to use web-based tool supporting sustainable land restoration, and readily accessible to restoration stakeholders. Utilising genomic analyses and environmental modelling techniques, the project is uncovering an unparalleled level of information to understand how genetic diversity is partitioned across the landscape, and if genetic provenances are associated with climatic and environmental variables. The project is collecting, analysing and sharing genetic, adaptive, environmental, and ecological data for over 200 plant species commonly used in restoration projects across Australia's Eastern seaboard and representing the region's floristic, ecological and phylogenetic diversity. This community resource aims to improve the success and long-term viability of land restoration projects, as well as improve predictive capacity to respond to climate change. The genetic data is used to identify local neighbourhood boundaries, to reduce relatedness, and to maximise diversity within specific climate-based scenarios. Interpretations are backed by an increasing number of collaborative experimental trials testing, for example, relative genetic fitness and climate adaptation profiles. Beside supporting restoration practices, the project will also provide significant information from species to landscape levels, discover regions of high genetic diversity, identify commonalities among taxonomic and functional groups that will improve our ability to generalise beyond the 200 species, and enable us to explore how species and assemblages are likely to respond through time.

Is restoration working? An ecological genetic assessment

Dr Melissa Millar WA Department of Department of Biodiversity, Conservation and Attractions
(co-authors David J Coates, Margaret Byrne, Siegfried L Krauss, Janet Anthony, Matthew R Williams, Rianne Fernandes, Justin Jonson, Stephen D Hopper)

The recognition of poorly defined success criteria and a lack of long term monitoring have highlighted the need for the development of post implementation empirical evaluations of the quality of ecological restoration activities. Most recently, the field has focused attention on the joint roles that ecological and genetic processes play in ensuring plant populations are self-sustaining, functional and possess the adaptive evolutionary potential that provides resilience to changing environments and persistence in both the short and long term. This recognition has led to the hypothesis that the most ecologically and genetically viable restored populations will be those where reproductive outputs, plant pollinator interactions, levels of genetic diversity, mating systems and patterns of pollen dispersal most closely mimic those found in natural or undisturbed remnant vegetation. Gondwana Link Ltd are leading an ambitious conservation and restoration initiative that aims to restore native vegetation, providing habitat connectivity and integrated ecosystem function at a regional scale. Restoration at a number of focus sites within the 'Fitz-Stirlings' (a 70 km section of fragmented mallee and woodland remnant vegetation located between the Fitzgerald River National Park and the Stirling Ranges National Park) have been assessed in terms of ecological and genetic function of restored plant populations. These suggest establishment from appropriate sized seed collections of local provenance and the general restoration of pollinator services and mating systems, while planting densities or spacing patterns and distance to nearby remnant populations influence patterns of pollen immigration and dispersal.

Maximising adaptive potential in translocated populations of clonal saltmarsh plants

Dr Karen Sommerville Royal Botanic Gardens & Domain Trust
(co-authors Alex Pulkownik, Maurizio Rossetto)

We investigated the implications of clonality for translocation of *Wilsonia backhousei*, a threatened, outbreeding, saltmarsh plant with tidally dispersed fruit. Eight microsatellite loci were used to characterise samples from three estuaries in New South Wales, Australia, and to determine the size and distribution of genetically distinct individuals (genets). Within-population diversity was compared to the presence or absence of seed production using the t test. Ordinal logistic regression was used to investigate the relative influence on seed yield of soil characteristics (soil moisture, salinity, pH) and the number of clonal lineages within a 5 and 10 m radius. Principal coordinate analysis, analysis of molecular variance and Bayesian analysis were used to investigate the extent of gene flow within and among the three estuaries. We found individual genets could cover extensive areas (up to 225 m2) and apparently large populations could consist of only a few individuals. Populations that failed to produce seed had significantly less genetic diversity than populations that produced seed ($P = 0.001$). Seed yield showed a significant positive response to both increasing soil moisture content ($P = 0.003$) and increasing genetic diversity in a 5 m radius ($P = 0.003$). Both factors explained poor seed set in a translocated population compared to a nearby natural population. Gene flow was found to occur chiefly within estuaries though occasional longer-distance gene transfer was evident. To maximise adaptive potential in translocated populations, we recommend sourcing propagules from multiple populations and planting representatives of each in close proximity to facilitate sexual reproduction.

Plant mating systems and assessing translocation success

Dr David Coates WA Department of Biodiversity, Conservation and Attractions
(co-authors Leonie Monks, Rebecca Dillan)

Many plant species targeted for reintroduction in Australia are relatively long lived and can provide significant challenges for evaluating translocation success given the timeframes over which they may reproduce and recruit. Flowering and fruiting may take years, even decades for some species. Most methodologies suggest assessing success depends on species moving through life stages (survival, reproduction, recruitment and dispersal) to indicate acclimation to, and persistence at, the new site. With funding cycles often significantly shorter than the decades it may take to demonstrate success, translocation of long lived plants poses significant challenges. Additionally recruitment may be linked to infrequent and sporadic disturbance events such as fire. Although traditional approaches are important and needed, other approaches can allow for more timely assessments of persistence and translocation success. One approach involves using genetic markers to estimate mating system parameters such as outcrossing rate and correlated paternity, which are not only useful indicators of inbreeding, reproductive output and long term population persistence but can also be used to infer pollinator presence and pollinator behaviour.

Translocation of the threatened rainforest herb, *Astelia australiana*

Linda Parker's University of Melbourne
(co-authors Dr Craig Nitschke, Dr Sabine Kasel, Dr Cristina Aponte)

Astelia australiana (Tall Astelia) (Asteliacea) is a threatened cool temperate rainforest species endemic to the Central Highlands (14 sites) and Otway Ranges (1 site) of Victoria. *A. australiana* has a narrow, fragmented distribution and its abundance, estimated at 10,000, has declined by 57% since 1993. Multiple factors are contributing to the species decline including changes in stand structure, disease, wildfire, and browsing by introduced deer. We conducted a trial translocation of 54 individuals to see if this was a potential management option for this species. Eighteen individuals were planted into three sites: the source (control) site, a locally absent site (beside the source site); and a new site (22 km away). We had between 89 - 83% survival at sites. We then conducted a second translocation to reduce the risk of a single wildfire taking out multiple sites and to mitigate the risk of changing climate on the species. This translocation involved 200 individuals from 5 source sites to the existing trial site (additional 25 individuals); and adding (25) individuals to a site that had recently become locally extinct (thought to be due to browsing by deer– now fenced to exclude browsing). We also established new populations of 50 individuals each at three new sites. We are currently conducting a genetic analysis across the species range to understand the within and between site gene flow dynamics of *A. australiana* to inform its future translocation management.

Breeding system and polyploidy in conservation management - the case of the woolly wrinklewort *Rutidosis lanata*

Dr Alexander Schmidt-Lebuhn, CSIRO
(co-authors David Marshall, Andrew Young)

To achieve better conservation outcomes, it is crucial to understand the biological traits of individual species. Unfortunately, in many cases such information is unavailable, especially for rare and threatened species. When populations of the southern Queensland endemic daisy *Rutidosis lanata* were impacted by resource development, offset actions were required, and low seed set was observed in natural populations. This suggested that reproductive output was suffering from some unknown factor, which would have to be resolved to enable successful seed production and translocation. We conducted crossing experiments and genetic analyses to test potential explanations and to develop targeted management guidelines based on our results. The study represents an example of how the interaction of two often-neglected factors, self-incompatibility and polyploidy, can influence management recommendations.

Interrogate then translocate: identifying potentially recipient sites by modelling the environmental niche of the endangered *Persoonia hindii*

Dr Nathan Emery Royal Botanic Garden and Domain Trust
(co-author Dr Cathy Offord)

Mine site restoration requires a long-term commitment to return plant species common to the pre-mining environment. The endangered *Persoonia hindii* occurs in scattered populations on Newnes Plateau in the Blue Mountains region of New South Wales, and is required as part of post-mining rehabilitation works conducted in the area. However, successfully translocating *P. hindii* has not yet been achieved due to a poor understanding of species biology. While recent work at the Australian Botanic Garden Mount Annan has since developed a successful propagation methodology for producing *P. hindii* plants for translocation, little is still known of the species' environmental tolerances. It is essential that this elementary ecological evidence is determined prior to commencing any translocation project. This presentation will outline our ecological assessment for *P. hindii* as part of the pre-translocation work, including the environmental niche modelling, field sampling and evaluation that then informs further planning. In particular, this method will help guide the preparation of post-mining sites for planting *P. hindii* as a model template that could be used for other species. Although a highly beneficial approach, as there is a level of uncertainty associated with niche modelling, an initial experimental planting is proposed to evaluate the effectiveness of this methodology.

Pollination of the threatened Canberra spider orchid, with a view to translocations

Tobias Hayashi Australian National University
(co-authors Dr. Noushka Reiter, Emma Cook, Prof. Rod Peakall)

Plant translocations are important tools to ensure the continued persistence of threatened species, and also provide the opportunity to raise awareness and conduct valuable research. Terrestrial orchids are over-represented as threatened flora and often have highly specific ecological interactions such as mycorrhizal fungi required for germination and reliance on one or few species of insect pollinators. Thus, they are challenging candidates for translocation projects and an in-depth understanding of their ecology is required. The Critically Endangered Canberra spider orchid, *Caladenia actensis*, is an iconic terrestrial orchid with a highly restricted distribution in the Mt Ainslie-Mt Majura area, making it one of only five vascular plant species endemic to the ACT. Here I present evidence that *C. actensis* attracts sexually deceived males of a single species of thynnine wasp (*Hymenoptera*, Tiphiidae). The wasp is an undescribed species probably belonging to an undescribed genus, and is likely to be the only regular pollinator of *C. actensis* flowers. Surveys of wasp distribution using artificial flower presentation throughout the Canberra region indicate the pollinator may be uncommon or have a restricted range. As part of the management plan for the Canberra spider orchid, current work within the ACT Government is focusing on habitat and climate modelling, increasing the genetic diversity of existing greenhouse plants, investigating mycorrhizal fungi distribution in the landscape, and conducting surveys of pollinators. Understanding the distribution of the pollinators, particularly if they are rare or localised, will be crucial in order to determine suitable areas for translocation.

Securing Silver Daisy – collaborative action to build resilience in a threatened daisy

Amelia Hurren Trees For Life
(co-authors Martin Breed, Colette Blyth, Andrew Lowe, Alex Mason, Rohan Cleeves)

Silver Daisy *Olearia pannosa ssp pannosa* is a Nationally Vulnerable species which is potentially at risk from climate change. We aim to demonstrate a method for building resilience in threatened plant communities in the face of climate change and will challenge long-held assumptions about prioritising local provenance for threatened plant translocations. Silver Daisy has a wide distribution across South Australia, from the west coast of Eyre Peninsula to the Southern Flinders Ranges, and down to Mount Gambier in the South-east. Another subspecies *O. p. ssp cardiophylla* occurs sympatrically with *O.p. ssp pannosa* and extends across the border into Victoria. Our project aims to build the resilience of *O. p. ssp pannosa* through targeted translocations to establish new populations on secure sites; retain genetic material from populations at high risk on the edge of the species' range and supplement the genetic diversity of small and low diversity populations. We will also attempt to determine the veracity of the two sub-species. The University of Adelaide is providing detailed genetic information of both subspecies, and ecological climate modelling to determine suitable future sites for translocation. Trees For Life will collect seed from across the range of the species, propagate seedlings based on the genetic analysis and undertake translocations with future climate envelopes in mind. We will also undertake threat abatement for high priority populations. All of our project activities will involve community members, including local community organizations, landholders and volunteers in an attempt to ensure the long-term custodianship of these populations.

PLENARY – Mammals – looking backwards, moving forwards

Dr Sarah Legge NESP Threatened Species Recovery Hub
(co-authors John Woinarski, Jeremy Ringma, Mike Bode, Andrew Burbidge, Jim Radford, Nicki Mitchell, Brendan Wintle)

Many Australian mammal species are highly susceptible to predation by introduced cats *Felis catus* and European red foxes *Vulpes vulpes*. These predators are the primary cause for Australia's record of having the worst mammalian extinction rate in modern times and they continue to cause distributional and population declines for extant species. Deliberate translocations of mammals to cat- and fox-free islands and fenced havens have become an increasingly used option for protecting Australian mammals imperilled by cats and foxes. We carried out an assessment of existing havens in Australia to assess the extent of their protection for the 67 threatened mammal taxa that are susceptible to cat/fox predation. Representation of taxa within havens was uneven, with some taxa represented in >10 havens, whilst other (29 taxa; 43%) are not represented in any havens. The haven network has grown through the de-centralised actions of many different government and non-government organisations, and private individuals. The network has substantially improved the conservation prospects of some species, but other species have missed out. We carried out a spatial optimisation analysis and found that a systematic planning approach to future network expansion could improve representation for all predator-susceptible mammal taxa. For example, by adding just 12 new havens, in the right place, we could protect at least one population of every predator-susceptible mammal taxon. We reflect on the future for havens as a conservation tool for mammals: havens are critical for avoiding extinctions in the short-term, but they cover a minute proportion of species' former ranges, and options for controlling the impacts of cats and foxes at landscape scales must be developed and implemented.

Bettongs as ecosystem engineers – the Mulligans Flat Woodland Experiment

Catherine Ross ANU Fenner School
(co-authors Sue McIntyre, Philip Barton, Saul Cunningham, Adrian Manning)

The Mulligans Flat-Goorooyarroo Woodland Experiment is located near Canberra in south-eastern Australia. This 'outdoor laboratory' provides an opportunity to trial a range of restoration techniques to inform the conservation of critically endangered box-gum grassy woodlands, including the reintroduction of several locally extinct species within a predator-proof sanctuary. Soil-foraging mammals such as bettongs, bandicoots and bilbies are known as ecosystem engineers because they modify habitats and resource availability for other species. The loss of many of these species is believed to have contributed to the decline of Australian ecosystems, and their reintroduction is seen as a possible tool for restoration. Since the successful reintroduction of eastern bettongs (*Bettongia gaimardi*) to Mulligans Flat Sanctuary in 2012, their digging behaviour has had a marked effect on ecosystem processes in the reserve. However, after an absence of over a century, the reintroduction of this ecosystem engineer may have unexpected consequences. I found that bettong digs provided a favourable niche for seed germination, particularly in dense grasslands where diggings create gaps which are vital for many species. Surprisingly, native species benefited more from the presence of diggings than exotic species. However, high rates of herbivory have also been observed for some species of native forbs, particularly the early nancy (*Wurmbea dioica*). My results indicate that bettongs play an important role as ecosystem engineers in grassy woodlands. Understanding these complex ecological relationships will have implications for management of bettongs within the reserve, as well as future reintroductions of animal and plant species.

PRESENTATIONS – DAY 2 (in order of appearance)

PLENARY – From a burnt-out basement to a new home in the sun: The role of ecological consultants in plant translocation

Belinda Pellow, AMBS Ecology & Heritage
(co-author Chantelle Doyle)

Ecological consultants work between legislation, development and biodiversity protection and this task requires a diverse set of skills. As part of the process we are increasingly called on to provide advice on threatened species management beyond avoidance and mitigation of impacts *in situ*. Removal of threatened plant species from a development footprint to an alternative location is now regularly recommended in impact assessments and required as a condition of development consent to offset impacts. However, these recommendations and decisions are seldom well informed by data on the likelihood of success or merit of alternative methods. Consultants are called on to balance aspiration, realism, costs and client satisfaction in the context of limited scientific evidence, while also meeting our ethical obligations. Well-designed monitoring is needed to improve understanding of the translocation process and build knowledge on species-specific requirements. Sharing this information, however, can sometimes be challenging depending on the willingness of clients who own the data. Few mechanisms or economic incentives exist to make translocation data from development projects available. Other historical impediments include the lack of a central repository for translocation data and the absence of statutory responsibilities to maintain data on this important aspect of plant conservation. Development of a systematic, publicly available information base of when, where and how plant translocations have succeeded or failed, and promoting the transfer of this knowledge should become important priorities for biodiversity conservation, particularly as translocations are increasingly relied upon to offset development impacts.

The status of the Australian native seed sector. Results from the ANPC native seed survey

Dr Nola Hancock Macquarie University
(co-authors Paul Gibson-Roy, Linda Broadhurst, Martin Driver)

The reliable supply of good quality, genetically diverse seed underpins every aspect of seed-based plant recovery and restoration. Disruptive forces such as climate change, fragmentation, genetically depauperate populations and proportionately less funding available for conservation poses questions on how the native seed sector is positioned to meet current and future demand for seed. In 2016/2017, the ANPC commissioned a survey to better understand the current status of the native seed sector to gather feedback on issues currently experienced within the sector. The results from the survey provide valuable insights into composition, structure and views of this sector. Expressed in the responses were key concerns that future seed demand will be difficult to meet from wild harvest; that current demand for seed is inconsistent and/or unpredictable and that the buying market is unwilling to pay for the true cost of seed collection/seed production. The survey also revealed that whilst a shortage of seed from common plant groups was not detected at present, there is a lack of seed available from a broad range of species – which is concerning given the increasing focus on 'whole community restoration'. Overwhelmingly, respondents voiced support for the formation of a representative industry group to represent the native seed sector in areas such as quality control and industry standards. The survey also provided new information on current provenance views and practices and well as confirming the increasing use of seed production to meet demand.

On the receiving end: long-term site management in the zone of the North Rothbury Persoonia

Monica Oppen Ant Press Bookbinding and Printmaking

I am not a scientist. I am an artist, a printmaker and bookbinder. In my work I constantly engage with our relationship with the natural world. My fascination with plants goes back to high school science.
In the 1990s I bought two blocks of land in the Lower Hunter Valley as the holiday get-away for the family. In 2008 I sold one and put the other under Conservation Agreement. In this presentation I would like to talk about the process applying for and gaining the Conservation Agreement, of becoming involved with the saving of *Persoonia pauciflora* and my active management of my block as a conservation area. Where scientists seem to be very focused in on particular species, I see the role of caretaker to be global and long-term. I understand saving a species as more than saving individual plants but as preserving the habitat in which the species occurs. It is challenging task because I have come to realise that my 14.5 ha block which is ex-farmland is in no way a stable biological/ecological community. The spread and diversity of plants has changed over the last 20 years and continues to change. I will talk about some of the projects I have undertaken and maintain on a continuing base and what the future holds.

Responding to the dreaded myrtle rust: a New Zealand botanic gardens perspective

Emma Bodley Auckland Botanic Gardens

Myrtle rust was first found in New Zealand in May 2017 on Raoul Island. A rapid response of various organisations throughout New Zealand was coordinated, drawing people of different skill sets and backgrounds. In this presentation, I will discuss from the Auckland Botanic Gardens perspective the response to myrtle rust in New Zealand. I will talk about our contribution as part of Auckland Council and the experience of being one of the first people with training for surveillance. I will also mention some key projects that we have initiated in response to myrtle rust such as keeping collections of wild collected Myrtaceae, our sentinel survey, partnering with horticulturists and arborists to give best practice advice, and investigating cultivar resistance. We have also received international funding to seed bank Myrtaceae on Great Barrier Island which has been a collaborative partnership to achieve national seed collection goals.

Restoring a Threatened Ecological Community following mining

Dr Lucy Commander Australian Network for Plant Conservation
(co-authors Luis Merino Martin, Peter Golos, Carole Elliott, Jason Stevens, Ben Miller)

Restoring plant communities following mining activities can be challenging, given the altered topography and soil properties, limited topsoil as a source of propagules, and unknown methods of plant return. And when the community to be restored is a Threatened Ecological Community (TEC), and Ministerial Conditions require that the mine replace 70% of the original species, then the challenge is even greater. Always up for a challenge, a multi-disciplinary team of researchers at Kings Park Science and the University of Western Australia, in partnership with Sinosteel Midwest Corporation has recently completed a 5-year project to attempt to do just that – restore 70% of the TEC species at an iron-ore mine on a banded ironstone formation in WA. Firstly, surveys were conducted to determine the composition of the community and determine the number of species required for restoration of a 7 ha area. Then, laboratory and field trials investigated the most effective method for plant return – whether through natural dispersal, topsoil, seed, seedling or cutting. Finally, a series of experiments were used to better understand the abiotic conditions and optimise the methods of plant return. The project culminated in a large field trial testing the effects of irrigation on seedling emergence from topsoil and a biodiverse seed mix, as well as survival of seedlings and cuttings, to work towards achieving 70% species return.

PLENARY – Translocating threatened plants: linking policy, planning and practice

Peter Latch Department of the Environment and Energy

Translocations of threatened species to support their recovery are important management responses that are increasingly being considered by threatened species managers across Australia. As with all management decisions, translocation requires considerable planning and must be considered within the mix of all potential interventions to meet the objectives of a threatened species recovery program. But given the legal protection afforded to listed threatened species, to what extent does legislation and policy inform or guide translocation decision making? With reference to the state of Australia’s threatened plants, we will provide an overview of the national policy context, identifying to what extent national conservation plans identify translocation actions. With over 1300 nationally listed threatened plant species each with plans in place of varying age, length and detail, translocation actions where identified, vary greatly in their specificity and link to clearly identified objectives. This highlights the challenges in not only planning for translocation, but also in building a national picture of translocation effort and measures of success. With a number of new planning and policy initiatives underway, including the ANPC guidelines, there are opportunities to better plan for, and progressively build that national translocation picture as an integral part of broader conservation effort.

A revised policy to support translocations in NSW

Dr Timothy Sutton NSW Office of Environment and Heritage
(co-author Linda Bell)

Recently revised with input from key stakeholders, the OEH translocation operational policy provides a decision making framework for the licensing of plant and animal translocations within, into or out of NSW. There are some key changes to the scope of the policy, including: extension of the policy to threatened and protected plants, threatened fauna and protected invertebrates; consideration of translocation from populations threatened by destruction due to development actions, and; establishment of *ex situ* plant and animal populations, where those populations will be used for translocation. The revised policy is timely, with the introduction of the Biodiversity Conservation Act 2016 and the formalisation of the Biodiversity Conservation Program, known as 'Saving our Species' (SoS). Under the SoS program, which aims to maximise the number of species secured in the wild for 100 years, translocation is identified as a priority SoS action for over 100 threatened plant species. Those actions include supplementing existing populations or establishing new population with vegetative material propagated *ex situ*. This paper will discuss how the OEH translocation operational policy applies to plant conservation, including the requirements of translocation proposals. It will also provide an overview of the SoS program and the role of translocation in achieving its objectives

Next generation conservation is needed to protect the dryland grassland biome of Australia

Dr Glenda Wardle University of Sydney

Conservation biology is a discipline familiar with crisis, but it has not, as yet, reflected that lens sufficiently well to scrutinise its own practices. Conservation largely plays catch up after development has taken its toll – and is, therefore, more reactionary than proactive in preventing environmental degradation and species loss. To move forward 'next generation conservation' (NGC) needs to build firmly on the multidimensional pillars of science, society and economics, as reflected in the United Nation's sustainable development goals and Future Earth. We also need to harness the frameworks of natural capital, ecosystem services and environmental economic accounting, to inform genuine progress indicators (i.e. not GDP), that deliver a sustainable economy built on living within our environmental means. Distinctive elements of NGC will include: future thinking, an integrated and dynamic systems approach, multidisciplinary solutions, integration of gender into biophysical research, and recognising rights for nature as well as for people. NGC should embed public engagement more deeply into the early stages of decision-making. These views reflect my personal experience informed, in part, by long-term studies in the hummock grasslands in central Australia, a biome that has largely been ignored but is now being targeted for intensive development. In a case study focused on this biome, I highlight the opportunities to avoid the poor practices of the past and to showcase what we have collectively learned about best-practices for securing better conservation outcomes for biodiversity and people. It is my pleasure to showcase the role of women in changing these practices.

Conserving Australia's forests and the importance of having a fit-for purpose biosecurity program

Francisco (Paco) Tovar Plant Health Australia

A strong biosecurity system that protects Australia from the deleterious effects of exotic organisms is a fundamental pillar for the maintenance and conservation of Australia's native flora. Australia's plant biosecurity system faces pressure in mitigating the risks posed by exotic pests, including pests that affect forests. Increasing levels of trade, movement of people and commodities as well as climate change are all contributing to an upward trend in exotic forest pest establishment in Australia. These exotic forest pests can result in significant economic, environmental and amenity costs. Confronting these challenges, the National Forest Biosecurity

Surveillance Strategy has been designed to implement a coordinated National Forest Pest Surveillance Program that is integrated with the broader plant biosecurity system. The Strategy presents an opportunity to establish a world-first surveillance program that involves partnerships across all forest stakeholders in government, industry and community. Benefits of such a program include the provision of evidence of pest status, maintaining trade and market access for forest-derived products and most importantly mitigating the environmental, social and environmental risks posed to Australia's forests by exotic pests.

Threatened plant translocations at Sydney's urban interface – where do we put them?

Dr Peter Cuneo Royal Botanic Gardens & Domain Trust - Australian Botanic Garden, Mount Annan
(co-authors Dr Nathan Emery, Graeme Errington, Dr Ahamad Sherieff & Daniella Pasqualini)

The urban development and settlement pattern of Sydney has resulted in significantly reduced, and highly fragmented remnant native vegetation. Despite this fragmentation, isolated populations of threatened plants still occur, and are now under significant pressure from urban development. This talk will focus on the ecology and translocation planning for the Bankstown Hibbertia (*Hibbertia puberula* subsp. *glabrescens*), a critically endangered plant only known from one small population occurring at a managed open grassland adjacent the Bankstown Airport runway. Facing an uncertain future and extremely high risk of extinction, this species has been identified by the OEH Saving our Species program as a priority for management actions; including translocation and establishment of new populations. Planning work for this translocation has included the difficult search for recipient sites, soil assessments, population genetics and seed germination/propagation research, and highlights the challenges facing conservation projects in highly urbanised environments. This talk will also examine threatened plant translocation options linked to large scale infrastructure projects in western Sydney, where there is increasing demand for translocations as a key strategy to offset development impacts.

Population biology with *Plantago lanceolata* as a model system – a focus on genetics and seed ecology

Stephanie Chen University of Sydney
(co-author Professor Glenda Wardle)

Ecological forecasting is crucial under increased environmental change to inform conservation decisions. However, the predictive capacity of models is currently limited by a lack of within-species sampling over large spatial extents. As part of the multi-site PlantPopNet collaboration (www.plantpopnet.com), we tested key assumptions of the matrix population model concerned with plant reproduction at the population level using the widespread species *Plantago lanceolata* (ribwort plantain). We found significant variation in plant density and clustering across the study site in Mount Annan, NSW and related these spatial patterns to traits from demographic surveys. We detected a low level of clonality (under 10 %) from the analysis of over 1200 genetic markers (SNPs). We carried out germination experiments on over 2500 seeds and found that seeds from the field population had a lower germination rate (14.7 %) compared to commercially produced seeds originating from the plant's native range (89.5 %). While a low number of seeds was found in the soil seed bank, Cox proportional hazard models uncovered that functional traits such as seed colour were strong predictors of the probability of germination. Finally, we considered the interaction between the clonal and seed reproduction pathways and demonstrated their antithetical effect on population growth rate. Recommendations for the future directions of PlantPopNet were developed based on our findings. It is anticipated that the PlantPopNet population models will allow us to understand plant populations in different environments and provide decision-making tools to effectively manage our ecosystems and natural resources.

Myrtle Rust poses unprecedented challenges for plant conservation and recovery

Bob Makinson

The Australian host list for the 'pandemic strain' of the invasive Myrtle Rust pathogen (*Austropuccinia psidii*) exceeds 360 native plant species, and can be expected to grow further. A recent review of the environmental impacts nominates 45 taxa known or suspected to be undergoing serious decline (four at a catastrophic level), or at very high risk. Some ecologically keystone species are highly susceptible. Ecosystem declines and some species extinctions are to be expected. Many of the most susceptible hosts are exposed to the airborne spores over their total range, with no refugia. For many of these, the rate of decline is likely to outstrip natural selection and dispersal of any disease-resistant genotypes, and niche closure may preclude natural recovery. Exclusion of *A. psidii* from Western Australia, and of further strains from the Australasian region, are national imperatives. A conservation response is feasible, but requires a level of national coordination and investment rarely seen for environmental threats (although common enough for agricultural pathogens). Such a response would involve uncomfortably interventionist approaches for an undetermined number of species, from enhancement of natural populations with resistant natural genotypes, through to selective breeding or engineering and re-wilding, translocation being involved in either case. The ecological, social, and technical issues are formidable, but not insoluble. For the most at-risk species, the preservation of any options requires urgent field survey, representative germplasm capture, and seed storage enablement research, as first steps. A draft Action Plan released in 2018 provides a framework for a national response.

Faster than nature does on its own: a story of saltmarsh restoration

Dr Paul Adam , University of NSW

Temperate coastal saltmarsh is an Endangered Ecological Community on the schedules of the Biodiversity Conservation Act (NSW) and a vulnerable community under the Commonwealth EPBC Act. A requirement for mitigation for loss of saltmarsh resulting from major road construction was imposed stipulating restoration of degraded saltmarsh at Kurnell, Botany Bay. The major cause of degradation was believed to be BMX and trail bike use. Prior to restoration commencing, off-road vehicles were excluded from the site. In early 2013 planting of *Sporobolus* and *Sarcocornia* occurred in 1 m radius quadrats. Other quadrats in bare areas were left planted, and further quadrats were established in remnant patches of saltmarsh. Monitoring has continued, with extensive revegetation by *Sarcocornia* occurring, but from natural recolonisation rather than by spread from the planted plots, suggesting that removal of threats, and permitting natural recolonisation, rather than relying on expensive replanting is an option to consider in appropriate circumstances.

What determines species distribution limits along an altitudinal gradient in Acacia?

Dr Paul Rymer , Western Sydney University
(co-authors Katie Rolls, Corey O'Brien)

This study investigates local adaptation in leguminous Acacia species along a natural altitudinal gradient in the Blue Mountains. This region is vulnerable to anthropogenic climate change with temperature warming, as well as, increased frequency and intensity of heat waves and droughts. Understanding how species cope under these changing conditions contributes to natural resource management strategies, the conservation of biodiversity, and enhanced primary production. It is necessary to understand what factors limit species' current distributions to determine how this may be affected by environmental change. As climate warms, species current ranges are expected to shift, forcing species to persist through these changes, adapt or perish. Plants that exhibit higher phenotypic plasticity will be better equipped to cope in a changing climate, while those more locally adapted may require translocations to more suitable climates. Transplant experiments with restricted and widespread Acacia were used to pull apart genetic and environmental factors determining distribution limits and local adaptation.

PLENARY – Ex situ seed banks are a good investment as small deposits drive big returns

Damian Wrigley Australian Seed Bank Partnership

Target 8 of the Global Strategy for Plant Conservation calls for 75% of known threatened plants to be secured in seed banks, with at least 20% available for restoration. This concept of seed use is a critical consideration for how seed banks can assist native plant conservation outcomes throughout Australia. Often thought to be a static endeavour, focussed on securing and storing germplasm for some unforeseen future use, seed banking is a dynamic, complicated and exciting component of plant conservation capable of supporting restoration and translocation actions for our most threatened native species. Seed banking is an active and participatory science that involves strong collaborations across governments, industries and communities to strategically target collections and actively utilise these resources for immediate actions and long-term conservation outcomes. Australia's seed banking sector has compiled a wealth of information and expertise that already supports translocations and restoration actions across a wide range of landscapes using a rich diversity of species. Examples to be explored include a selection of the 50 translocations performed in WA using seed from the Threatened Flora Seed Centre as well as work by the WA Seed Technology Centre that focussed on *Ricinocarpos brevis* and *Androcalva perlaria*; a conservation partnership in South Australia's Mount Lofty Ranges that used seed from a multitude of herbaceous species and typical sedges such as *Chorizandra enodis* and *Carex inversa*; an example from the Victorian Conservation Seedbank that saw *Ballantinia antipoda* produced in vast quantities over several seasons for translocations at select sites; and a project in NSW where the Australian PlantBank worked with government partners and the local community to successfully translocate *Persoonia pauciflora* both within and outside of its native range.

Leek Orchids vs. Extinction: A New Hope

Marc Freestone Australian National University/Royal Botanic Gardens Victoria
(co-authors Noushka Reiter, Celeste Linde, Nigel Swarts)

It is the afternoon of the 7th February 2009. Enormous bushfires bear down on Yan Yean Reservoir, a water supply north of Melbourne and home to the only population of the Tan Leek-orchid (*Prasophyllum erythrocommum*). It's an emergency situation and in an attempt to protect the catchment, authorities construct a fire break around the catchment - right through the Tan Leek-orchid population. A wind change spares the catchment, but surveys in following wet years fail to relocate the orchid. No seed was ever collected. It is now almost certainly extinct. The fourth species of its genus to become so in the last half century in Victoria alone. Leek Orchids (*Prasophyllum*) are in trouble. They are the fifth-largest genus of plants on the EPBC Act with 39 species listed, many of which are on the absolute brink with tiny, declining, wild populations. While being endangered isn't unique to Leek Orchids, they face a problem that most EPBC Act-listed plants don't face: we don't know how to grow them in cultivation. Or didn't. Current research at ANU and the Royal Botanic Gardens Victoria is shining new light on these reclusive plants. By investigating seed viability, cultivation practices, and relationships between the orchids and symbiotic fungi, we are beginning to get an understanding of what makes these plants tick. This talk will present preliminary findings that have the potential to stop critically endangered species of Leek Orchids from going extinct by enabling *ex situ* breeding programs.

Western Australia's safe deposit box

Dr Anne Cochrane , formerly WA Department of Biodiversity, Conservation and Attractions
(co-author Dr Andrew Crawford)

The flora of South-West Western Australian, like many Mediterranean-climate floras, is both diverse and highly threatened, with many species at risk of extinction. Conserving plant species *in situ* is the primary focus of conservation in the state, complemented by *ex situ* actions such as the use of seed banking to provide an insurance policy against extinction. To be effective, conservation seed banks will utilise their stored seed to aid species recovery in translocations or scientific research. This paper highlights the benefits and challenges of making and using *ex situ* collections through a series of examples drawn from the past 25 years from the Department of Biodiversity, Conservation and Attractions' Threatened Flora Seed Centre. Examples aim to demonstrate a range of approaches used to achieve the desired conservation outcomes. Early identification of species at risk and timely collections has helped to ensure a broad genetic representation of target species. When faced with difficulties in accessing sufficient seed material, multi-year sampling and seed orchard establishment has proved beneficial. Monitoring of plant populations during seed collections and seed research has enabled informed decisions on future translocations. Together, these examples will demonstrate the necessity to be proactive in our efforts to conserve threatened plant species and to remain flexible in the approaches we take. They highlight how *ex situ* seed collections when used for translocation can make a significant contribution to ongoing species knowledge, persistence and survival.

Playing to our Strengths: Applying horticulture and advocacy to threatened plant conservation at Auckland Botanic Gardens

Rebecca (Bec) Stanley Auckland Botanic Gardens
(co-authors Jack Hobbs, Emma Bodley)

For conservation purposes the primary strengths of Auckland Botanic Gardens are our horticultural expertise and high number of visitors (over 1 million annually). Applying these strengths in partnerships with others has underpinned our conservation efforts for the past 25 years. Our conservation goals are achieved mainly through *ex situ* collections of plants but also the programmes to engage the broader community with the plight of threatened plants to generate wider support for their protection. Our *ex situ* role includes seed orchards and seed banking, research on propagation of plants not cultivated before, training in restoration techniques, working with local communities and indigenous people to return plants to the wild, promoting threatened plant use in gardens and using garden design (and interpretation) to communicate the plight of NZ threatened plants. The NZ botanic garden alliance (part of the wider Botanic Gardens Australia New Zealand network or BGANZ) has recently signed an agreement to work in partnership with NZ's Department of Conservation to provide a shared national overview to align and prioritise plant conservation projects and ensure coordination of threatened plant management on the ground between agencies.

Ex situ seed conservation to furnish translocation and restoration: securing currency in the bank, and how to grow it

Dr Caroline Chong National Seed Bank, Australian National Botanic Gardens & Parks Australia, Department of the Environment and Energy

Establishing *ex situ* conservation collections of seeds and plants including in seed banks and botanic gardens is a critical action to secure plant populations against the risk of threatening processes. The germplasm resources and ecological data generated through *ex situ* conservation support translocation and restoration planning and outcomes. High quality seed collections with a broad genetic base can provide the basis of successful conservation efforts because it underpins efficient maintenance of genetic resources to support species survival in natural and restored environments. Seed biology research addresses knowledge gaps in species traits, guides how to store and propagate seed and increases our capacity to predict responses to environmental conditions during vulnerable germination and growth life stages. Data on seed germination, dormancy and longevity contribute knowledge of how plant species and ecological communities will perform under translocation, restoration and climate scenarios. In this talk I will discuss the key steps, benefits and challenges of *ex situ* seed conservation and research including limited prior data on species traits and limited windows of opportunity to secure plants and seeds. I will highlight partnerships and policy that direct *ex situ* conservation prioritisation and outcomes, and will draw on case studies from the National Seed Bank's work on the *ex situ* conservation of threatened and significant Australian plant species.

Seed Resources for Restoration

Dr Paul Gibson-Roy Greening Australia

Seed is the fundamental unit required for restoration, whether for propagating plants for tubestock planting or for direct seeding. This presentation will give an overview of the many factors involved in developing the necessary seed resources for restoration. It will focus a broad range of issues including planning, licensing, genetics, collection approaches and technologies, seed processing, handling and testing. It will also address the area of seed production looking at production models, the types of machinery and infrastructure inputs and overall costs.

Cassinia tegulata survival linked to fire

Bryan Haywood Nature Glenelg Trust

Low intensity autumn burning is considered an essential method to increase the numbers of plants per population of *Cassinia tegulata*. This species is a nationally threatened plant and the bulk of the population occurs in SA in the upper south east. The populations occur mainly on roadsides from Kingston across to Lucindale and up to Desert Camp. One additional colony is known from near Edenhope in Victoria. All populations in SA except one are declining rapidly with no recruitment observed. One new population was created through revegetation back 2010/11 on private land. This *ex situ* population (of over 60 plants) existed to 2017 in good condition however also with no recruitment. Revegetation is one method to increase the population of a plant, however natural processes like 'burning' were considered a viable option. In May 2017, NGT undertook a small burn of this *ex situ* private land population. The burn area was about 200-250 sqm, approximately a quarter of the planted area. This burn successfully opened up the dense grassy/sedgey habitat, scorched and burnt a few adult plants, and has assisted in a four-fold increase to the population in just 12 months with flowering observed the following autumn. What a great result from minimal resourcing. We are in the planning stages to arrange a larger burn on a roadside crown land population in autumn 2019.

Responses of nitre goosefoot (*Chenopodium nitrariaceum*) to simulated rainfall, and depth and duration of experimental flooding

Will Higgisson University of Canberra
(co-authors Sue Briggs, Fiona Dyer)

Nitre goosefoot (*Chenopodium nitrariaceum* (F.Muell.) is a woody shrub that occurs at the edges of floodplains and other intermittently flooded areas across the Murray Darling Basin. No studies have been conducted on the hydrological requirements of nitre goosefoot, and the species is not considered in watering requirements of floodplain species of the Murray Darling Basin. This study investigated effects of simulated rainfall and depth and duration of experimental flooding on mortality, leaf production, biomass, and seed production of nitre goosefoot. Nitre goosefoot plants were grown from seeds collected near Hillston, New South Wales, Australia. The plants were subjected to 14 hydrological treatments: dry (no water applied), rainfall (simulating rainfall conditions at Hillston), and 12 combinations of three water depths (10 cm, 50 cm, 75 cm) with four durations of inundation (5 days, 10 days, 20 days, 40 days). The study found that nitre goosefoot plants survived flooding providing plants were not totally submerged, leaf production increased during flooding and after drawdown, and leaf production, biomass and seeding were highest under shallow flooding for a month or so. The results of study allow the hydrological requirements of nitre goosefoot to be considered in environmental watering programs.

POSTERS (in alphabetical order)

PERRI – Platform for Ecological Restoration Research Infrastructure

Dr Linda Broadhurst CSIRO
(co-authors Suzanne Prober, Guy Boggs, Martin Breed, Sacha Jellinek, Jasmyn Lynch, Paul Rymer, Peter Harrison, Fiona Dickson, David Bush)

Hundreds of localised experiments are rolled out across Australia every year as part of funded and unfunded restoration programs and projects. The untapped wealth of these experiments to generate broader generalities across diverse landscapes to better improve restoration practice and outcomes at a national level has yet to be realised. Here, our concept is a Platform for Ecological Restoration Research Infrastructure (PERRI) to build a co-ordinated, nationally distributed network of ecological restoration experiments embedded within more extensive restoration plantings. PERRI will enable us to better answer key ecological questions at a national scale such as (i) How resilient are local species and provenances to global change? (ii) Are there costs and benefits of using non-local species and provenances for future proofing restoration plantings? (iii) How should we be re-establishing complex communities? and (vi) What establishment techniques should we use in anthropogenically modified landscapes? The networked approach will allow increased statistical power to detect genotype-by-environment interactions at a broader scale than can be achieved with trials at individual sites. As part of our PERRI proposal we are developing National Guidelines to inform the establishment of these experiments which will be available for feedback in 2019.

Applying seed ecology of Australian native species to enhance seed-based restoration in degraded habitats

Fernanda Caro Beveridge University of Queensland
(co-authors Professor Steve Adkins, Dr Alwyn Williams)

Australia is home to an extraordinary diversity of plant life, the majority of which is endemic. This unique diversity is threatened by numerous pressures, such as habitat destruction and land degradation. In extreme, but frequent cases, this results in a deeply eroded and damaged habitat, making it hard for natural regeneration to take place. Land revegetation using Australian native seeds (i.e., seed-based restoration) could be a feasible and effective option for achieving this objective. Seed characteristics like seed fill, viability, and dormancy are critical factors that affect the rate and percentage of seeds germinating at any given time, and are therefore fundamental to the success of seed-based restoration efforts. However, these characteristics are often not known in advance, reducing the predictability and cost-effectiveness of using seeds for revegetating degraded lands. To overcome these issues and improve seed-based restoration outcomes, it is essential to study the seed ecology of Australian native species in order to understand the environmental cues needed to trigger germination, and how these requirements may be met by artificial methods. Moreover, the use of seed enhancing technologies could be a powerful approach to improve germination success by broadening environmental thresholds needed for seed germination, thereby increasing germination rate and uniformity. To realise the potential of seed-based restoration, further research is required regarding species-specific techniques to trigger germination and methods of providing adequate environments for seedling establishment.

Making a difference: the impact of seed conservation and translocation on threatened plant recovery

Dr Anne Cochrane formerly WA Department of Biodiversity, Conservation and Attractions
(co-authors Dr Andrew Crawford, Ms Leonie Monks)

Implementing effective conservation strategies is essential to stem the loss of global biodiversity. Seed banks deliver one of a number of important strategies for supporting the conservation of threatened plant species. Seed banks collect, evaluate and store seeds under conditions that minimise seed deterioration as an insurance against species or population loss. Adequate collections of viable seed with a broad genetic base are required to provide effective support for conservation activities such as threatened species translocation. The goals of translocation are to increase plant numbers, create or maintain self-sustaining populations and ideally down-grade a species from its threatened ranking, thereby positively affecting the conservation status of the species. Evaluating the success of each step of the translocation process, from seed germination through to survival of reproducing adults on the ground, can help prioritise and set targets for future seed collection. Here we highlight the benefits of integrating ex situ seed storage and plant translocation programs to help provide for better conservation outcomes. We use Western Australian examples to illustrate how translocation supported by seed conservation is making an important contribution towards improving conservation status of a wide range of threatened species across this unique global biodiversity hotspot.

Using simulation models to improve effectiveness of plant population offsetting in short-lived perennials

Dr Francisco Encinas-Viso CSIRO

Biodiversity offsetting is a tool to compensate for impact on biodiversity from development activities. Current guidelines and plant population offsetting practices lack scientific support and generally ignore the biology of the targeted species to estimate offset success. Considering life-history traits (e.g. type of mating systems), genetics and demography is crucial to improve estimations of viability and extinction risk. Here we developed a spatially and genetically explicit demographic model of a generic self-incompatible perennial herb to evaluate and quantify multiple management strategies under different environmental scenarios to increase population viability. Our findings suggest that combined management actions augmenting spatial availability and genetic diversity increases up to 50 % population viability and population persistence. We also found that mitigating mortality factors (e.g. fire, weed competition) was as important as increasing offset size to maximise offset success. Our work sheds light on the importance of accounting for demography, genetics and life-history traits to improve current plant population offsetting practices, as well as the use of computer simulations to explore the feasibility of management strategies for restoration work.

Raising Rarity

Dr Megan Hirst, Royal Botanic Gardens Victoria
(co-authors John Delpratt, Dr Susan Murphy)

Many of Australia's rare plant species are restricted to specialised ecosystems that are severely threatened by habitat loss, fragmentation, genetic isolation and, more recently, climate change. In this 2-year project we will assess public and commercial responses to a range of Victoria's rare and threatened wildflower species identified on the basis of their horticultural potential. We are investigating the germination, container culture and performance in outdoor beds of 20 rare perennial herbaceous species from specific habitats, selected for their form, foliage or flowers. We are sowing field-collected seed from the Victorian Conservation Seedbank at the Royal Botanic Gardens Victoria. The project includes species originating from alpine habitats, swamps and wetlands, and drier heathlands and grasslands. Species include *Celmisia sericophylla*, *Craspedia canens*, *Leptorhynchos orientalis*, *Leucochrysum albicans* subsp. *tricolor*, *Lobelia gelida*, *Podolepis muelleri*, *Rutidosis leptorhynchoides*, *Swainsona pyrophila* and *Xerochrysum palustre*. In the first year, conventional nursery container systems are being used to grow species from seed and to document their performance and variation in pot culture. Individual plants with horticultural merit, specifically robust forms suited to container production, will be selected and propagated clonally or from seed. We will also maintain and grow on the broader range of plant forms, present in the initial seed-raised population, to retain genetic diversity and to assess their seed production potential for future ecological re-introductions. In the second year, forms selected for their horticultural merit will be planted and grown in outdoor beds at the Royal Botanic Gardens Cranbourne, to assess public and commercial interest in each species.

A genetic assessment of diversity and structure among remnant stands of Sweet Quandong (*Santalum acuminatum*, Santalaceae): the implications for seed sourcing

Dr Susan Hoebee La Trobe University
(co-authors Jeremy Benwell-Clarke, Dr Linda Broadhurst)

Careful selection of optimal seed provenance and quality greatly influences the success of plant restoration projects. The genetic assessment of seed sources can aid land managers to develop appropriate seed sourcing strategies where genetic diversity is maximised and balanced against local adaptation concerns. Microsatellite loci were used to characterise 14 populations (N = 150 samples) of the root hemiparasite Santalum acuminatum across northern Victoria and southern NSW. Only 30 multilocus genotypes were identified with extensive clonality within populations but no genetic structure among populations. The presence of three alleles at multiple loci in some genotypes and size comparison of stomatal length together suggested a mix of diploid and triploid populations in the landscape. We recommend that seed for restoration projects should be collected from multiple populations (to ensure seedlots are genetically diverse) and could be moved across the study area without compromising restoration success so long as mixing of ploidy is avoided.

Making the most of 20 million trees – embedding a provenance trial

Dr Paul Rymer , Western Sydney University
(co-authors Corey O'Brien, Courtney Sullivan)

The recent funding of 20 million trees has created opportunities for revegetation across Australia. The success of the program for ecological restoration has been limited in that funds for other greater plant diversity, ecosystem function, and experimental plantings is lacking. Motivated by the developing Platform for Ecological Restoration Research Infrastructure (PERRI) this research project was initiated as a partnership with Greening Australia and Western Sydney University. Here funding was available for the planting of tree and shrubs with tube stock in Western Sydney Parklands. Additional resources to establish a large scale experimental planting has been quantified from seed sourcing, nursery preparation, site marking and layout, as well as mapping and monitoring. Preliminary results on the establishment success will be presented, along with a discussion on how to move local plantings to national experiments.

Genetic diversity in natural and restored populations of *Grevillea wilkinsonii*

Amy Westman Molino Stewart
(co-authors John Briggs, Martin Henery, Zoe Knapp, David Hunter, Linda Broadhurst)

Grevillea wilkinsonii (Tumut grevillea, Proteaceae) is an endangered perennial shrub endemic to New South Wales that is listed as Endangered under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and the NSW Threatened Species Conservation Act 1995. This species has a highly restricted range, occurring as a series of small remnant patches along a 20 km stretch of the Goobarrangandra River near Tumut in south-east NSW and in a small isolated population near Gundagai. Recovery efforts for this species include fencing to protect and augment existing natural populations as well as establishing new populations using plants propagated from seed and by cuttings. This poster reports our assessment of genetic diversity in new and established populations to inform future conservation and management of *Grevillea wilkinsonii*.

PRESENTER BIOGRAPHIES (in alphabetical order)

Dr Paul Adam has worked on saltmarshes for 50 years, and has carried out autecological, phytosociological and conservation based projects at a range of locations, and has advised on a number of salt marsh restoration projects.

Emma Bodley works at the Auckland Botanic Gardens (ABG) as the Botanical Records and Conservation Specialist. She has worked at ABG for four and a half years. Her work at ABG involves managing the plant collections database and overseeing conservation projects at the gardens.

Dr Linda Broadhurst has worked at CSIRO since 2000 after completing her PhD at Curtin University of Technology in Perth followed by a short Post-doctoral position with the then Department of Conservation and Land Management (CALM). Her research is primarily focussed on conserving and restoring the long-term prospects of Australia's unique floral biodiversity. Her most recent research is assisting NRMs and NGOs establish good seed sourcing and production practices to help restored populations respond to changing environments.

Dr Margaret Byrne undertakes plant conservation and evolutionary genetics research with a current focus on climate adaptation, and is responsible for science and conservation policy as Executive Director, Biodiversity and Conservation Science, Western Australian Department of Biodiversity, Conservation and Attractions.

Fernanda Caro Beveridge has a bachelor degree in Agronomy, specialised in crop sciences from the Pontifical Catholic University of Chile, an Honours thesis *Characterization of a Chilean native coastal sand dune vegetation* and is undertaking her MPhil in Australian native species and their use in seed-based restoration at the University of Queensland.

Stephanie Chen is an Honours student at the University of Sydney interested in plant science, genetics, and applied statistics.

Dr Caroline Chong is a seed conservation biology researcher with a focus on threatened species and continuing interests in plant conservation genetics, drivers of population variation and persistence in extreme environments, with prior post-doctoral research with CSIRO, Australian National University and the University of Connecticut.

Dr David Coates is a Senior Principal Research Scientist in the Department of Biodiversity, Conservation and Attractions, Western Australia. His research interests cover threatened plant species recovery, translocations and restoration, conservation genetics, evolutionary biology and managing threats such as habitat fragmentation and Phytophthora dieback.

Dr Anne Cochrane is a former scientist with the WA government where she managed a conservation seed bank for 25 years. She has served on the steering committee of the Australian Seed Bank Partnership and is a long-time member of the ANPC.

Dr Lucy Commander is the Project Manager of the revision of the ANPC's Guidelines for Translocation of Threatened Plants in Australia. She has a background in seed ecology and restoration of plant communities following mining.

Dr Peter Cuneo is Manager Seedbank & Restoration Research at the Australian PlantBank (Australian Botanic Garden Mount Annan) and leads the seedbank and threatened species program. Peter's current research interests are threatened species translocation and ecological restoration using direct seeding.

Dr Nathan Emery works with industry and stakeholders leading research at the Australian Botanic Garden Mount Annan on the propagation, seed biology, reproductive ecology, and restoration programs of several rare and threatened eastern Australian *Persoonia* species.

Dr Francisco Encinas-Viso is a research scientist at the Australian National Herbarium (CSIRO). His main research areas of interest are evolutionary ecology and conservation biology, he is particularly interested in plant-pollinator interactions and the use of modelling approaches to applied ecological questions.

Marc Freestone is a PhD Candidate with ANU, based at the Orchid Conservation Program at the Royal Botanic Gardens Victoria. His passion for orchid conservation dates back to his days as a consultant botanist when he documented the extinction of the Tan Leek-orchid.

Dr Paul Gibson-Roy has been involved in the field of restoration for two decades. His primary focus has been on the restoration of complex species-rich grassy communities.

Tobias Hayashi is a PhD candidate in the Peakall lab at the ANU. He is passionate about photography and orchids, and is particularly interested in the interaction between the orchids and their pollinators.

Dr Nola Hancock is a researcher in the Department of Biological Sciences at Macquarie University and has worked on a diverse range of climate-adaptation projects within the Biodiversity Node of the NSW Adaptation Research Hub.

Bryan Haywood has over 20 years of professional and volunteering experience in south-east SA and south-west Vic, and is an accomplished and widely respected field naturalist with a particular passion for ornithology and entomology. Bryan has excellent knowledge of regional flora and vegetation communities and has coordinated the Restoring Under-represented Ecological Communities project from 2014-2018.

Will Higgisson is a PhD student studying the importance of flooding on plants which occur on semi-arid floodplains.

Dr Megan Hirst, Seedbank officer at the Royal Botanic Gardens Victoria, is interested in assessing horticultural approaches to help in the conservation of rare and threatened Australian wildflowers.

Dr Susan Hoebee – Through studies of plant reproduction, population genetics and evolution, my research group aims to better understand how plant populations change over time and how increasing degrees of population isolation and/or fragmentation can affect the long-term survival of a species.

Amelia Hurren manages Trees For Life's Bush For Life program. Amelia has worked in nature conservation for 22 years including private, government and not-for profit sectors. Amelia's experience includes threatened species recovery, bush regeneration, volunteer management, policy and community engagement.

Dr Rebecca Jordan is interested in how we can use genomic tools to help inform conservation management. She uses landscape genomic approaches to explore genetic diversity and adaption across plant species' distributions, aiming to understand adaptability to environmental change.

Dr Siegy Krauss is a conservation geneticist working with researchers and practitioners for practical outcomes in plant conservation and ecological restoration.

Peter Latch has many years of experience working within local, state and Federal government agencies in protected area management, biodiversity planning and threatened species conservation. He is Director Terrestrial Threatened Species and works with many groups across the country to facilitate national recovery planning efforts for threatened species.

Dr Sarah Legge is a Deputy Director of the NESP Threatened Species Recovery Hub. She is an applied ecologist, her research focusses on finding ways to reduce the impacts of threats on threatened species.

Bob Makinson is a conservation botanist and plant taxonomist, and vice-president of ANPC. Since 2010 he has been working on Myrtle Rust, and recently completed a national review of the environmental impacts of the pathogen and a draft action plan.

Dr Melissa Millar is a Research Scientist with the WA Department of Department of Biodiversity, Conservation and Attractions. She conducts research that contributes to the circumscription, conservation and management of the WA flora. She is currently the Secretary of the ANPC.

Monica Oppen I am not a scientist. I am an artist, a printmaker and bookbinder. In my work I constantly engage with our relationship with the natural world. My fascination with plants goes back to high school science.

Linda Parker's PhD thesis examined the ecology of the threatened rainforest herb *Astelia australiana* (Tall Astelia). She found that its populations have declined by 57% in 20 years due to multiple factors including disease, wildfire, herbivory and low light availability.

Dr John Patykowski is a plant biologist interested in the patterns and processes of community assembly, factors that shape plant traits and adaptations, and how natural and anthropogenic disturbance affects biological communities and the contributions of species to ecosystem functioning.

Belinda Pellow has worked for over 30 years in university herbaria and as an ecological consultant. Belinda was lead author on the 5th edition of the *Flora of the Sydney Region*. She is currently President of the Ecological Consultants Association of NSW.

Catherine Ross is a PhD student at the ANU Fenner School, studying the ecology and restoration of grassy woodlands.

Dr Maurizio Rossetto heads the Evolutionary Ecology section at the National Herbarium of NSW and combines genetic, environmental and functional data to support flora management and conservation.

Dr Paul Rymer combines classical and novel ecological and molecular techniques to address outstanding questions in evolutionary ecology. His research focuses on the ecology and evolution of organisms in natural populations, in particular plant-animal interactions, mating patterns, hybridisation and local adaptation, and how these factors drive and erode species diversity. His research is applied to understanding the origin of biodiversity hotspots, the evolution of invasiveness, and adaptation to climate change.

Dr Alexander Schmidt-Lebuhn is a CSIRO research scientist at the Australian National Herbarium in Canberra. His work focuses on the systematics and evolution of native Asteraceae (daisy family), polyploidy, pollination, and user-friendly identification keys.

Dr Jen Silcock is a post-doctoral researcher with the National Environmental Science Program's Threatened Species Recovery Hub. She also has long-term research interests in the Australian arid zone, including historical ecology, rare and threatened flora and fauna, grazing and fire impacts, and long-term vegetation change.

Dr Karen Sommerville is a Scientific Officer of the Royal Botanic Gardens & Domain Trust. Her research interests have ranged from saltmarsh plants to alpine seeds, terrestrial orchids and rainforest plants. Her current research is focussed on the *ex situ* conservation of rainforest seeds.

Rebecca (Bec) Stanley is the Curator at Auckland Botanic Gardens and has been involved in *ex situ* and *in situ* threatened plant conservation for twenty years. She is currently working on behalf of Botanic Gardens in New Zealand to ensure the *ex situ* capacity in Gardens is available for plant conservation projects.

Dr Timothy Sutton is a Senior Project Officer at the NSW Office of Environment and Heritage, where he develops operational policies to support conservation in NSW. He attained a PhD in fig wasp molecular ecology from Western Sydney University in 2016.

Francisco (Paco) Tovar is the National Forest Biosecurity Coordinator tasked with promoting and implementing biosecurity capacity building activities set out under the National Forest Biosecurity Surveillance Strategy that are aimed at protecting Australia's forests.

Dr Peter Vesk completed BSc & MSc degrees at University of Sydney, before a PhD at Macquarie working on Plant Functional Types, Grazing and Fire. After a post doc at Monash working on landscape reconstruction in wheat-sheep areas, he moved to University of Melbourne. His work has two themes: generalisation of species knowledge and ecological management. Much of his work draws on modelling and analysis.

Alicia Wain, the founder of Ecologica Consulting, is a Plant Ecologist with over 14 years' experience working within a multitude of ecological communities throughout Queensland. This experience has gained her recognition as a suitably qualified and experienced Ecologist by both the State and Commonwealth environment agencies.

Dr Glenda Wardle is a Professor of Ecology and Evolution at the University of Sydney. Glenda is passionate about using ecological knowledge to provide solutions for the challenges we face in living good lives and keeping the planet intact for future generations.

Amy Westman studied Ecology and Zoology (Honours Class I) at the University of Queensland, and recently started working for an environment and natural hazards company. Amy's recent Honours project explored the effect of urbanisation on insect pollinators. Presentation will be by Linda Broadhurst.

Damian Wrigley is the National Coordinator of the Australian Seed Bank Partnership. He coordinates national and international ex-situ seed conservation, capacity building and research collaborations on behalf of the Partnership. Previously the Knowledge Broker for the National Environmental Science Program, Damian has over ten years' experience in biodiversity conservation policy and environmental science. Damian is Australia's National Focal Point for the Global Strategy for Plant Conservation.